



Science Standards of Learning

Teacher Resource Guide

Earth Science

**Commonwealth of Virginia
Department of Education
Richmond, Virginia
2000**

Standard ES.1 a, b

The student will plan and conduct investigations in which

- volume, area, mass, elapsed time, direction, temperature, pressure, distance, density, and changes in elevation/depth are calculated utilizing the most appropriate tools; and
- technologies, including computers, are used to collect, analyze, and report data and to demonstrate concepts and simulate experimental conditions.

Essential Understandings	Essential Knowledge and Skills
Density expresses the relationship between mass and volume.	<u>Skills</u> <ul style="list-style-type: none">• Measure mass and volume of materials in the lab.• Calculate density.• Interpret data from a graph or table that shows change in mass, density, or temperature with time.• Interpret data from a graph or table that shows changes with temperature or pressure with depth.

Standard ES.1 c, d, e

<p>The student will plan and conduct investigations in which</p> <ul style="list-style-type: none">• scales, diagrams, maps, charts, graphs, tables, and profiles are constructed and interpreted;• variables are manipulated with repeated trials; and• a scientific viewpoint is constructed and defended.	
Essential Understandings	Essential Knowledge and Skills
<ul style="list-style-type: none">• Information and data collected can be organized and expressed in the form of charts, graphs, and diagrams.• Changing relevant variables will generally change the outcome.• A hypothesis can be supported, modified, or rejected based on collected data.• Experiments are designed to test hypotheses.	<p><u>Skills</u></p> <ul style="list-style-type: none">• Compare topographic maps of different scales.• Construct a graph, table, chart, and/or diagram from data.• Interpret graphs and diagrams.• Use the scientific method to design and test a hypothesis.

Standard ES.2 a, b, c, d, e, f

The student demonstrates scientific reasoning and logic by

- analyzing how science explains and predicts the interactions and dynamics of complex Earth systems;
- recognizing that evidence is required to evaluate hypotheses and explanations;
- comparing different scientific explanations for the same observations about the Earth;
- explaining that observation and logic are essential for reaching a conclusion;
- evaluating evidence for scientific theories related to plate tectonics, the structure of the Earth, and its ancient age and origin; and
- making informed judgments related to resource use and its effects on Earth systems.

Essential Understandings	Essential Knowledge and Skills
<ul style="list-style-type: none">• The Earth is a dynamic system and all atmospheric, geological, and oceanographic processes interrelate and influence one another.• Conclusions are only as good as the quality of the collected data.• Any valid hypothesis can be tested.• Any valid scientific theory has passed tests designed to invalidate it.• A hypothesis can be supported, modified, or rejected based on collected data.• Experiments are designed to test hypotheses.• There can be more than one explanation for any phenomena.	<p><u>Skills</u></p> <ul style="list-style-type: none">• Make predictions using scientific data and data analysis.• Use data to support or reject a hypothesis.• Explain how the scientific method is used to validate scientific theories.

Standard ES.3 a, b, c, d

The student will investigate and understand how to read and interpret maps, globes, models, charts, and imagery. Key concepts include

- maps (bathymetric, geologic, topographic, and weather) and star charts;
- imagery (aerial photography and satellite images);
- direction and distance measurements on any map or globe; and
- location by latitude and longitude and topographic profiles.

Essential Understandings	Essential Knowledge and Skills
<ul style="list-style-type: none">• Scale relates to actual distance.• Topographic maps, air photos, and satellite images relate to actual 3-D landforms.• Grid systems are used to define locations and directions on maps, globes, and charts.	<p><u>Skills</u></p> <ul style="list-style-type: none">• Read and interpret maps, including legends and lines (e.g., contour and isobar) used on maps.• Locate points and directions on maps and globes using latitude and longitude.• Construct profiles from topographic contours.• Determine distance and elevation on a map.• Identify a hilltop, stream, and valley on a topographic map.

Standard ES.4 a

The student will investigate and understand the characteristics of the Earth including

- plate tectonics.

Essential Understandings	Essential Knowledge and Skills
<ul style="list-style-type: none">• The core, mantle, and crust of the Earth are dynamic systems, constantly in motion.• The Earth's lithosphere is divided into plates that are in motion with respect to one another.• Most geologic activity (e.g., earthquakes, volcanoes, and mountain building) occurs as a result of relative motion along plate boundaries.• Plate motion occurs as a consequence of convection in the mantle.• There are two different types of crust (oceanic and continental) that have very different characteristics.	<p><u>Knowledge</u></p> <ul style="list-style-type: none">• The Earth consists of a solid, mostly iron inner core; a liquid, mostly iron outer core; a rocky, plastic mantle; and a rocky, brittle crust.• The lithosphere is the solid outer shell of Earth.• Relative plate motions and plate boundaries are convergent (subduction and continental collision), divergent (sea-floor spreading), or transform.• Earthquake activity is associated with all plate boundaries.• Major features of convergent boundaries include collision zones (folded and thrust-faulted mountains) and subduction zones (volcanoes and trenches).• Major features of divergent boundaries include mid-ocean ridges, rift valleys, and volcanoes.• Major features of transform boundaries include strike-slip faults.

Standard ES.4 a (continued)

Essential Understandings	Essential Knowledge and Skills
	<ul style="list-style-type: none">• Ocean crust is relatively thin, young and dense.• Continental crust is relatively thick, old, and less dense.• Continental drift is a consequence of plate tectonics.• Hot spot volcanic activity is exceptional in that it is not related to plate boundaries.

Standard ES.4 b, d

The student will investigate and understand the characteristics of the Earth including

- water in all three states; and
- effects of density differences and energy transfer on the activities of the atmosphere, oceans, and Earth's interior.

Essential Understandings	Essential Knowledge and Skills
<ul style="list-style-type: none">• Water occurs on earth as a solid (ice), a liquid, or a gas (water vapor).• Temperature differences produce differences in density, which produces convection.	<p><u>Knowledge</u></p> <ul style="list-style-type: none">• Convection is a current that is set up when hot, less dense material rises, cools, becomes denser, and sinks.• Convection is the major mechanism of energy transfer in the oceans, atmosphere, and Earth's interior.• Convection in the atmosphere is a major cause of weather.• Plate tectonics is driven by convection in the Earth's mantle.• Some ocean currents are convection currents.

Standard ES.4 c

The student will investigate and understand the characteristics of the Earth including

- position of the Earth in the solar system.

Essential Understandings

The Earth is one of nine planets in the solar system.

Essential Knowledge and SkillsKnowledge

The Earth is the third planet from the sun.

Standard ES.5 a, b

The student will investigate and understand how to identify major rock-forming and ore minerals based on physical and chemical properties. Key concepts include

- properties including hardness, color and streak, luster, cleavage, fracture, and unique properties; and
- use of minerals.

Essential Understandings	Essential Knowledge and Skills
<ul style="list-style-type: none">• There is a difference between rocks and minerals.• Minerals can be identified based on specific chemical and physical properties.• Minerals are important to human wealth and welfare.	<p><u>Knowledge</u></p> <ul style="list-style-type: none">• A mineral is a naturally-occurring, inorganic, solid substance with a definite chemical composition and structure.• Minerals may be identified by their physical properties such as hardness, color, luster, and streak.• Most rocks are made of one or more minerals.• Some major rock-forming minerals are quartz, feldspar, calcite, and mica.• Ore minerals include pyrite, magnetite, hematite, galena, halite, graphite, and sulfur.

Standard ES.6 a, b, c

The student will investigate and understand how to identify common rock types based on mineral composition and textures and the rock cycle as it related to the transformation of rock types. Key concepts include

- igneous (intrusive and extrusive);
- sedimentary (clastic and chemical); and
- metamorphic (foliated and unfoliated) rocks.

Essential Understandings	Essential Knowledge and Skills
<ul style="list-style-type: none">• Rocks can be identified on the basis of mineral content and texture.• The three major groups of rocks are defined by the processes by which they are formed.• The rock cycle describes the processes by which one type of rock can be changed into another type of rock.	<p><u>Knowledge</u></p> <ul style="list-style-type: none">• Igneous rock forms from molten rock that cools and hardens either below or on the Earth's surface.• Sedimentary rocks form from rock fragments or organic matter bound together, or are formed by chemical precipitation.• Metamorphic rocks form by the effects of heat, pressure, or chemical action on other rocks.• Extrusive igneous rocks have small crystals and a fine-grained texture.• Intrusive igneous rocks have larger crystals and a coarse-grained texture.• Extrusive igneous rocks include pumice, obsidian, and basalt.

Standard ES.6 a, b, c (continued)

Essential Understandings	Essential Knowledge and Skills
	<ul style="list-style-type: none">• Intrusive igneous rocks include granite.• Sedimentary rocks are clastic or nonclastic.• Clastic sedimentary rocks are made up of fragments of other rocks and include sandstone, conglomerate, and shale.• Non-clastic sedimentary rocks include limestone and gypsum.• Metamorphic rocks can be foliated or unfoliated.• Foliated metamorphic rocks have fine layers and include slate, schist, and gneiss.• Unfoliated metamorphic rocks have few or no layers and include marble and quartzite. <p><u>Skills</u></p> <ul style="list-style-type: none">• Interpret the rock cycle diagram.• Classify the following rock types as igneous, metamorphic, or sedimentary: pumice, obsidian, basalt, granite, sandstone, conglomerate, shale, limestone, gypsum, slate, schist, gneiss, marble, and quartzite.

Standard ES.7 a, b, c, d, e

The student will investigate and understand the difference between renewable and nonrenewable resources. Key concepts include

- fossil fuels, minerals, rocks, water, and vegetation;
- advantages and disadvantages of various energy sources;
- resources found in Virginia;
- use of resources and their effects on standards of living; and
- environmental cost and benefits.

Essential Understandings	Essential Knowledge and Skills
<ul style="list-style-type: none">• All resources are limited and either renewable or non-renewable.• There are advantages and disadvantages to using any energy source.• Virginia has many natural resources.• Modern living standards are supported by extensive use of both renewable and non-renewable resources.• Extraction and use of any resource carries an environmental cost that must be weighed against economic benefit.	<p><u>Knowledge</u></p> <ul style="list-style-type: none">• Renewable resources can be replaced by nature at a rate close to the rate at which they are used.• Renewable resources include vegetation, sunlight, and surface water.• Non-renewable resources are renewed very slowly or not at all.• Non-renewable resources include coal, oil, and minerals.• Fossil fuels are non-renewable and cause pollution, but they are relatively cheap and easy to use.• Major Virginia rock and mineral resources include coal for energy, gravel and crushed stone for road construction, and limestone for making concrete. Virginia also has newly discovered deposits of titanium.

Standard ES.8 a

The student will investigate and understand geological processes including plate tectonics. Key concepts include

- how geologic processes are evidenced in the physiographic provinces of Virginia including the Coastal Plan, Piedmont, Blue Ridge, Valley and Ridge, and Appalachian Plateau.

Essential Understandings	Essential Knowledge and Skills
<ul style="list-style-type: none">• Virginia has a billion-year long tectonic and geologic history.• Virginia has five physiographic provinces produced by past tectonic and geologic activity.• Each province has unique physical characteristics resulting from its geologic past.• Geologic processes produce characteristic structures and features.	<p><u>Knowledge</u></p> <ul style="list-style-type: none">• The five physiographic provinces are Coastal Plain, Piedmont, Blue Ridge, Valley and Ridge, and Appalachian Plateau.• The Coastal Plain is a flat area underlain by young, unconsolidated sediments. These layers of sediment were produced by erosion of the Appalachian Mountains and then deposited on the Coastal Plain.• The Piedmont is an area of rolling hills underlain by mostly ancient igneous and metamorphic rocks. The igneous rocks are the roots of volcanoes formed during an ancient episode of subduction that occurred before the formation of the Appalachian Mountains.• The Blue Ridge is a high ridge separating the Piedmont from the Valley and Ridge Province. The billion-year old igneous and metamorphic rocks of the Blue Ridge

Standard ES.8 a (continued)

Essential Understandings	Essential Knowledge and Skills
	<p>are the oldest in the state. Some metamorphism of these rocks occurred during the formation of the Appalachian Mountains.</p> <ul style="list-style-type: none">• The Valley and Ridge province is an area with long parallel ridges and valleys underlain by ancient folded and faulted sedimentary rocks. The folding and faulting of the sedimentary rocks occurred during a collision between Africa and North America. The collision, which occurred in the late Paleozoic, produced the Appalachian Mountains.• The Appalachian Plateau has rugged irregular topography and is underlain by ancient, flat-lying sedimentary rocks. The area is actually a series of plateaus separated by faults. Most of Virginia's coal resources are found in the plateau province. <p><u>Skills</u> Label a map of the physiographic provinces of Virginia.</p>

Standard ES.8 b, c

<p>The student will investigate and understand geological processes including plate tectonics. Key concepts include</p> <ul style="list-style-type: none">• processes (faulting, folding, volcanism, metamorphism, weathering, erosion, deposition, and sedimentation) and their resulting features: and• tectonic processes (subduction, rifting and seafloor spreading, and continental collision).	
Essential Understandings	Essential Knowledge and Skills
<p>There is a relationship among weathering, erosion, and deposition.</p>	<p><u>Knowledge</u></p> <ul style="list-style-type: none">• A fault is a break or crack in the Earth's crust along which movement has occurred.• Most active faults are located at or near plate boundaries. Earthquakes result when movement occurs along a fault.• When rocks are compressed horizontally, their layers may be deformed into wave-like forms called folds. This commonly occurs during continental collisions.• A volcano is an opening where magma is erupted onto the Earth's surface. Most volcanic activity is associated with subduction, rifting or sea-floor spreading.• Weathering is the process by which rocks are broken down by the action of water, air, and organisms.• Erosion is the process by which earth materials are transported by moving water, ice, or wind.

Standard ES.8 b, c (continued)

Essential Understandings	Essential Knowledge and Skills
	<ul style="list-style-type: none">• Deposition is the process by which Earth materials carried by wind, water, or ice settle out and are deposited.• Weathering accelerates erosion and thus increases the rate of deposition.• The potential for erosion is greatest in areas of high relief.• The potential for deposition is greatest in areas of low relief, especially standing water, and particularly the ocean.

Standard ES.9 a, b

The student will investigate and understand how freshwater resources are influenced by geological processes and activities of humans. Key concepts include

- processes of soil development; and
- development of karst topography.

Essential Understandings	Essential Knowledge and Skills
<ul style="list-style-type: none">• Soil is formed by the weathering of rocks and organic activity.• Karst topography is developed in areas underlain by carbonate rocks including limestone.	<p><u>Knowledge</u></p> <ul style="list-style-type: none">• Soil is loose rock fragments and clay derived from weathered rock mixed with organic material.• Karst topography includes features like caves and sinkholes.• Karst topography forms when limestone is slowly dissolved away by slightly acidic groundwater.• Where limestone is abundant in the Valley and Ridge province of Virginia, karst topography is common.

Standard ES.9 c, d, e

The student will investigate and understand how freshwater resources are influenced by geological processes and the activities of humans. Key concepts include

- identification of groundwater zones including water table, zone of saturation, and zone of aeration;
- identification of other sources of freshwater including aquifers with reference to the hydrologic cycle; and
- dependence on freshwater resources and the effects of human usage on water quality.

Essential Understandings	Essential Knowledge and Skills
<ul style="list-style-type: none">• A substantial amount of water is stored in permeable soil and rock underground.• The Earth's fresh water supply is finite.• Water is continuously being passed through the hydrologic cycle.• Fresh water is necessary for survival and most human activities.	<p><u>Knowledge</u></p> <ul style="list-style-type: none">• Permeability is a measure of the ability of a rock or sediment to transmit water or other liquids.• Water does not easily pass through impermeable materials.• Geological processes, such as erosion, and human activities, such as waste disposal, can pollute water supplies. <p><u>Skills</u></p> <ul style="list-style-type: none">• Interpret a simple groundwater diagram showing the zone of aeration, the zone of saturation, the water table, and an aquifer.• Interpret a simple hydrologic cycle diagram, including evaporation, condensation, precipitation, and runoff.

Standard ES.10 a, d

The student will investigate and understand that many aspects of the history and evolution of the Earth and life can be inferred by studying rocks and fossils. Key concepts include

- traces of remains of ancient, often extinct life are preserved by various means in many sedimentary rocks; and
- rocks and fossils from many different geologic periods and epochs are found in Virginia.

Essential Understandings	Essential Knowledge and Skills
<ul style="list-style-type: none">• Evidence of ancient, often extinct life is preserved in many sedimentary rocks.• Fossil evidence indicates that life has changed and become more complex over geologic time.	<p><u>Knowledge</u></p> <ul style="list-style-type: none">• A fossil is the remains, impressions, or other evidence of the former existence of life preserved in rock.• Some ways in which fossils can be preserved are molds, casts, and original bone or shell.• Almost all fossils are found in sedimentary rocks.• In Virginia, fossils are found mainly in the Coastal Plain, Valley and Ridge, and Appalachian Plateau provinces.• Most Virginia fossils are of marine organisms. This indicates that large areas of the state have been periodically covered by seawater.• Paleozoic, Mesozoic, and Cenozoic fossils are found in Virginia. <p><u>Skills</u></p> <p>Describe how life has changed and become more complex over geologic time.</p>

Standard ES.10 b, c

The student will investigate and understand that many aspects of the history and evolution of the Earth and life can be inferred by studying rocks and fossils. Key concepts include

- superposition, cross-cutting relationships, and radioactive decay are methods of dating bodies of rock; and
- absolute and relative dating have different applications but can be used together to determine the age of rocks and structures.

Essential Understandings	Essential Knowledge and Skills
<ul style="list-style-type: none">• The Earth is very ancient, about 4.6 billion years old.• The history of the Earth and the ages of rocks can be investigated and understood by studying rocks and fossils.	<p><u>Knowledge</u></p> <ul style="list-style-type: none">• Relative time places events in a sequence without assigning any numerical ages.• Fossils, superposition, and cross-cutting relations are used to determine the relative ages of rocks.• Absolute time places a numerical age on an event.• Radioactive decay is used to determine the absolute age of rocks. <p><u>Skills</u></p> <p>Interpret a simple geologic history diagram using superposition and cross-cutting relations.</p>

Standard ES.11 a

The student will investigate and understand that oceans are complex, interactive physical, chemical, and biological systems and are subject to long- and short-term variations. Key concepts include

- physical and chemical changes (tides, waves, currents, sea level and ice cap variations, upwelling, and salinity concentrations).

Essential Understandings	Essential Knowledge and Skills
The ocean is a dynamic system in which many chemical and physical changes are taking place.	<u>Knowledge</u> <ul style="list-style-type: none">• The tides are the daily, periodic rise and fall of water level caused by the gravitational pull of the sun and moon.• Most waves on the ocean surface are generated by wind.• There are large current systems in the oceans that carry warm water towards the poles and cold water towards the equator.• Sea level falls when glacial ice caps grow and rises when the ice caps melt.• Upwellings bring cold, nutrient-rich water from the deep ocean to the surface and are areas of rich biological activity.• Estuaries, like the Chesapeake Bay, are areas where fresh and salt water mix, producing variations in salinity and high biological activity.

Standard ES.11 b, e

The student will investigate and understand that oceans are complex, interactive physical, chemical, and biological systems and are subject to long- and short-term variations. Key concepts include

- importance of environmental, geologic, and economic implications; and
- public policy issues concerning the oceans.

Essential Understandings	Essential Knowledge and Skills
<ul style="list-style-type: none">• The oceans are environmentally and economically important.• Human activities and public policy have important consequences for the oceans.• The oceans' resources are finite and can be overexploited.	<p><u>Knowledge</u></p> <ul style="list-style-type: none">• Algae in the oceans are an important source of atmospheric oxygen.• The oceans are an important source of food and raw materials.• Pollution and over-fishing can harm or deplete valuable resources.

Standard ES.11 c, d

The student will investigate and understand that oceans are complex, interactive physical, chemical, and biological systems and are subject to long- and short-term variations. Key concepts include

- systems interactions (energy transfer, weather, and climate); and
- features of the seafloor (continental margins, trenches, mid-ocean ridges, and abyssal plains) reflect tectonic processes.

Essential Understandings	Essential Knowledge and Skills
<ul style="list-style-type: none">• The ocean is the single largest reservoir of heat at the Earth's surface.• The topography of the seafloor is at least as variable as that on the continents.	<p><u>Knowledge</u></p> <ul style="list-style-type: none">• The stored heat in the ocean drives much of the Earth's weather.• The stored heat in the ocean causes climate near the ocean to be milder than climate in the interior of continents.• Features of the seafloor that are related to plate tectonic processes include mid-ocean ridges and trenches.• Other major topographic features of the oceans are continental shelves, continental slopes, abyssal plains, and seamounts.

Standard ES.12 a, b

The student will investigate and understand the origin and evolution of the atmosphere and the interrelationship of geologic processes, biologic processes, and human activities on its composition and dynamics. Key concepts include

- scientific evidence for atmospheric changes over geologic time; and
- current theories related to the effects of early life on the chemical makeup of the atmosphere.

Essential Understandings	Essential Knowledge and Skills
The composition of the Earth's atmosphere has changed over geologic time.	<u>Knowledge</u> <ul style="list-style-type: none">• The early atmosphere contained little oxygen and more carbon dioxide than the modern atmosphere.• Early photosynthetic life (algae and blue-green algae) generated oxygen and consumed carbon dioxide.• It was only after early photosynthetic life generated oxygen that animal life became possible.

Standard ES.12 c

The student will investigate and understand the origin and evolution of the atmosphere and the interrelationship of geologic processes, biologic processes, and human activities on its composition and dynamics. Key concepts include

- comparison of the Earth's atmosphere to that of other planets.

Essential Understandings	Essential Knowledge and Skills
The Earth's atmosphere is unique in the solar system in that it contains substantial oxygen.	<u>Knowledge</u> <ul style="list-style-type: none">• The Earth's atmosphere is 21 percent oxygen, 78 percent nitrogen, and 1 percent trace gases.• The atmosphere of Venus is mostly carbon dioxide and very dense.• The Martian atmosphere is very thin and mostly carbon dioxide.

Standard ES.12 d, e

<p>The student will investigate and understand the origin and evolution of the atmosphere and the interrelationship of geologic processes, biologic processes, and human activities on its composition and dynamics. Key concepts include</p> <ul style="list-style-type: none">• atmospheric regulation mechanisms; and• potential atmospheric compositional changes due to human, biologic, and geologic activity.	
Essential Understandings	Essential Knowledge and Skills
<p>The composition of the atmosphere can change due to human, biologic, and geologic activity.</p>	<p><u>Knowledge</u></p> <ul style="list-style-type: none">• Human activities have increased the carbon dioxide content of the atmosphere.• Man-made chemicals have decreased the ozone concentration in the upper atmosphere.• Volcanic activity and meteorite impacts can inject large quantities of dust and gases into the atmosphere.• The ability of the Earth's atmosphere to absorb and retain heat is affected by the presence of gases like water vapor and carbon dioxide. <p><u>Skills</u></p> <p>Explain how volcanic activity or meteor impacts could affect the atmosphere and life on Earth.</p>

Standard ES.13 a, b, c

The student will investigate and understand energy transfer between the sun, Earth, and the Earth's atmosphere drives weather and climate on Earth. Key concepts include

- observation and collection of weather data;
- prediction of weather patterns; and
- weather phenomena and the factors that affect climate.

Essential Understandings	Essential Knowledge and Skills
<ul style="list-style-type: none">• Weather and climate are different.• The Earth's surface is much more efficiently heated by the sun than is the atmosphere.• The amount of energy reaching any given point on the Earth's surface is controlled by the angle of sunlight striking the surface and varies with the seasons.• Winds are created by uneven heat distribution at the Earth's surface and modified by the rotation of the Earth.• Energy transfer between the Earth's surface and the atmosphere creates the weather.• Both weather and climate are measurable and, to a certain extent, predictable.	<p><u>Knowledge</u></p> <ul style="list-style-type: none">• Weather describes day-to-day changes in atmospheric conditions.• Climate describes the typical weather patterns for a given location over a period of many years.• Areas near the equator receive more of the sun's energy per unit area than areas nearer the poles.• The conditions necessary for cloud formation are: air is at or below dew point; and condensation nuclei are present.• Cloud droplets can join together to form precipitation.• The four major factors affecting climate are latitude, elevation, proximity to bodies of water, and position relative to mountains.

Standard ES.13 a, b, c (continued)

Essential Understandings	Essential Knowledge and Skills
	<ul style="list-style-type: none">• The Coriolis effect causes deflections of the atmosphere due to the rotation of the Earth.• The Coriolis effect helps to create the global wind pattern.• A tornado is a narrow, violent funnel-shaped column of spiral winds that extends downward from the cloud base to Earth.• A hurricane is a tropical cyclone (counterclockwise movement of air) characterized by sustained winds of 120 kilometers per hour or greater. <p><u>Skills</u></p> <ul style="list-style-type: none">• Label a diagram of global wind patterns.• Read and interpret data from a thermometer, a barometer, and a psychrometer.• Read and interpret a weather map.• Identify cirrus, cumulus, and stratus clouds.

Standard ES.14 a

The student will investigate and understand the planets and other members of the solar system: the history and contributions of the space program; and the concept related to the origin and evolution of the solar system, galaxy, and universe. Key concepts include

- characteristics of the sun, planets, their moons, comets, meteors, and asteroids.

Essential Understandings	Essential Knowledge and Skills
The solar system consists of many types of celestial bodies.	<u>Knowledge</u> <ul style="list-style-type: none">• The sun consists largely of hydrogen gas. Its energy comes from nuclear fusion of hydrogen to helium.• There are essentially two types of planets in our solar system.• The four inner (terrestrial) planets consist mostly of solid rock.• Four of the outer planets are gas giants, consisting of thick outer layers of gaseous materials, perhaps with a small rocky core.• The fifth outer planet Pluto has an unknown composition, and appears solid.• Moons are natural satellites of planets that vary widely in composition.

Standard ES.14 a (continued)

Essential Understandings	Essential Knowledge and Skills
	<ul style="list-style-type: none">• Comets orbit the sun and consist mostly of frozen gases.• Asteroids are rocky or metallic iron objects ranging in size from millimeters to kilometers. They are the source of most meteorites.• Much of our knowledge about the solar system is a result of space exploration efforts. These efforts continue to improve our understanding of the solar system.• Apollo 11 was the first manned landing on the moon. <p><u>Skills</u> Draw a diagram of the solar system and label the planets.</p>

Standard ES.14b

The student will investigate and understand the planets and other members of the solar system: the history and contributions of the space program; and the concepts related to the origin and evolution of the solar system, galaxy, and universe. Key concepts include

- cosmology and the origin of the stars and stellar systems (the Big Bang, the solar nebular theory, stellar evolution, star systems, nebulae, constellations, and galaxies).

Essential Understandings	Essential Knowledge and Skills
<ul style="list-style-type: none">• The universe is vast and very old.• The Big Bang Theory is our best current hypothesis for the origin of the universe.• The solar nebular theory is our best current hypothesis for the origin of the solar system.• Stars have a finite lifetime and evolve over time.• The mass of a star controls its evolution, length of its lifetime, and ultimate fate.	<p><u>Knowledge</u></p> <ul style="list-style-type: none">• The Big Bang Theory states that the universe began as a dense sphere that expanded and eventually condensed into galaxies.• The solar nebular theory explains that the planets formed through condensing of the solar nebula.• Stars form by condensation of interstellar gas.• Galaxies are collections of large numbers (billions) of stars. The sun is in the Milky Way galaxy.• The solar system is located in the Milky Way Galaxy.• The basic types of galaxies are spiral, elliptical, and irregular.

Standard ES.14 b (continued)

Essential Understandings	Essential Knowledge and Skills
	<ul style="list-style-type: none">• A light-year is the distance light travels in one year and is the most commonly used measurement for distance in astronomy.• Much of our information about our galaxy and the universe comes from ground-based observations.• The Hubble Space telescope has greatly improved our understanding of the universe.